TENNESSEE HIGHER EDUCATION COMMISSION

Agenda Item: I.A.1.

DATE: January 29, 2004

SUBJECT: University of Tennessee Chattanooga, Ph.D. in Computational Engineering

ACTION RECOMMENDED: Approval

BACKGROUND INFORMATION: In 2001, nineteen academic and research faculty, staff and ten graduate students from Mississippi State University were recruited to UTC to establish the SimCenter. This research center is the cornerstone for the proposed Ph.D. in Computational Engineering. The goal of the proposed program is to integrate the research of the SimCenter with the educational objectives of the Graduate School of Computational Engineering. The SimCenter is committed to developing a strong base in externally sponsored research programs, served primarily by academic and research faculty. These research programs will provide numerous opportunities to incorporate each student's research into the overall research effort. The proposed program is designed to create a unique educational environment that will allow students to gain experience as a member of a multidisciplinary team, using simulation and modeling to solve complex engineering problems.

PROPOSED START-UP DATE: Upon approval

Commission staff have reviewed the program proposal according to the academic standards adopted by the Commission on November 14, 2002. Each standard is referenced below.

1.1.20A MISSION: The proposed program is consistent with the role and scope of the university. "UTC is dedicated to the education of students: to providing quality education to a diverse population of students to…enlighten and discipline their minds and their preparation for ethical and active leadership in civic, cultural, and professional life." UTC is committed to "utilizing its intellectual resources and external partners to serve as a "national model of an engaged metropolitan university…"

1.1.20B CURRICULUM: Computational Engineering is a field that builds on the fundamentals of traditional engineering programs in mathematics and computer science to create modeling and simulations. The proposed program is designed to educate students in a team-oriented, multidisciplinary environment, focusing on large-scale and complex practical engineering problems. The curriculum is designed to provide students with the sub-disciplines of engineering applications, scientific supercomputing, and mathematics of computation. The curriculum will be tailored to the background and research goals of each student. The curriculum requires 72 semester hours beyond the baccalaureate degree, including the four new courses required to complete the curriculum.

Projected Program Productivity

Student Projections	FTE Enrollment	Graduates
Year 1	5.3	0
Year 2	7.7	1
Year 3	8.0	2
Year 4	9.0	2
Year 5	9.3	3

1.1.20C ACADEMIC STANDARDS: The proposed program is open to qualified students who have completed a bachelor's or master's degree. Admission requires an application, statement of purpose, references, and the GRE. Admittance also requires compatibility of research interests with the SimCenter. Students must achieve satisfactory performance in research and progress toward graduation and maintain a "B" average on all undergraduate prerequisites and graduate courses. The admission requirements were described by the consultant as stringent.

1.1.20D FACULTY: The faculty for the proposed program has degrees in mathematics, aerospace, mechanical computational engineering, and other related engineering disciplines. Several senior faculty members have long-term experience in computational fluid dynamics research and multiple career experiences in industry, academia and government. The faculty has numerous publications and presentations of national and international scope, and has served as principal investigators for large government/industrial sponsored research. There is a full staff of 19 academic and research faculty to support the proposed program.

1.1.20E LIBRARY RESOURCES: Minimum acquisitions of library resources are required to support the proposed program. Most are available through electronic databases.

1.1.20F ADMINISTRATION/ORGANIZATION: The proposed program will be administratively housed in the Graduate School, College of Engineering and Computer Science.

1.1.20G SUPPORT RESOURCES: The UTC Foundation has provided support to establish the SimCenter through a $100 million endowment received in 1999.

1.1.20H FACILITIES/INSTRUCTIONAL EQUIPMENT: The new $28.8 million, state-of-the-art Engineering, Mathematics and Computer Science Building at UTC will house the proposed program. The City of Chattanooga gave the former TVA Solar Building to UTC to house the SimCenter. The UTC Foundation donated $2.5 million to renovate the building, located adjacent to the UTC campus. This facility contains offices and work spaces for students and faculty, as well as the on-site high performance computing equipment necessary to support computational engineering research and education.

1.1.20I STUDENT/EMPLOYER DEMANDS: During the consultant visit to UTC, the students that relocated from Mississippi State University expressed a strong interest in the proposed program in computational engineering. One of the co-founders of the National Science Foundation Engineering Research Center for Computational Field Simulation in Mississippi indicated that in the ten years the program was in operation at MSU, enrollment increased by 40 percent. Experts predict that the trend of using computers to solve complex, large-scale practical engineering problems will accelerate. As an emerging branch of engineering, the employment outlook for students is encouraging nationwide. According to a UTC survey, 50 percent of the students in engineering expressed an interest in computational engineering. Ten former Mississippi State University graduate students relocated with faculty to continue their graduate program at UTC. The proposed program will attract students nationally to work with the faculty and research of the SimCenter.

1.1.20J NO UNNECESSARY DUPLICATION: The proposed program is not duplicative of any programs in Tennessee or the Southeast. It differs from other Engineering or Computer Engineering programs by the strong emphasis on research driven by practical engineering applications, the team teaching/research approach to solve large-scale complex problems and the collaborative partnership with the SimCenter.

1.1.20K COOPERATIVE INSTITUTIONS: As a separate entity from the SimCenter, the proposed program will serve as the cornerstone to support doctoral students in computational engineering and other graduate programs in engineering and computer science.

1.1.20L DESEGREGATION: The program will not impede the state's effort to achieve racial diversity.

1.1.20M ASSESSMENT/EVALUATION AND ACCREDITATION: The undergraduate programs at UTC in engineering and computer science are accredited by ABET, which accredits programs, not program levels. The current accreditation status also will extend to the proposed program upon approval.

1.1.20N ARTICULATION: N/A

1.1.20O EXTERNAL JUDGMENT (Graduate Programs**):** The proposed program is based on the principles set forth by the Tennessee Council of Graduate Schools. On September 7- 9 2003, an external review was conducted by Dr. L.S. (Skip) Fletcher, who serves as an administrator with NASA Ames. He currently is on loan from Texas A&M University, where he is the Dean of the College of Engineering. Dr. Fletcher, selected by THEC in collaboration with the University of Tennessee System staff, strongly endorsed the proposed program. He indicated that the partnership and support with the SimCenter will be instrumental in the Ph.D. receiving national recognition in the field of simulation and computational engineering.

1.1.20P COST/BENEFIT/SOURCE: In 2002, the UTC Foundation contributed nine million dollars to establish a premier computational engineering research group. The location and support resources of the SimCenter make it possible to offer the proposed

program at minimum costs to the State of Tennessee. The substantial investments by the City of Chattanooga, the UC Foundation, private gifts, and large scale externally funded research grants and contracts provide the start-up operating costs and long-term funding base.

The following are expected outcomes and benefits as a result of an innovative high-quality doctoral program in computational engineering:

- Enhance UTC's ability to secure funding through competitive grants and private foundations,
- Enable students to pursue graduate study through model of integration of research and education and the expertise and experience of a broad range of academic and research professionals,
- Help attract and retain outstanding faculty and expand the options for graduates entering the job market, and
- Enhance the ability to attract new technology investments to enhance the economic development in the Chattanooga metropolitan area.

Cost of Supporting Graduate Students

GRA Stipends $174K (Gifts and Grants) Tuition and Fee Waivers $81.4K (Gifts and Grants)

The proposed program can be operated by the existing faculty comprised of the new SimCenter faculty and the other current UTC Engineering faculty. The cost of GRA stipends, research supervision and miscellaneous expenses including student equipment, library and travel will be funded from gifts and external research grants. The only new costs to the State are the cost of teaching 50% of the courses, and CmE program administrative costs.

Other Estimated Costs

- SimCenter faculty and staff salaries are funded by external research, except for teaching courses, thesis/dissertation supervision, and educational administrative costs. External research also funds graduate assistantship stipends and indirect and administrative expenses supporting research.
- Computing Facilities will be supplied under an existing agreement with Oak Ridge National Laboratory, as well as the existing and currently funded facilities of the UT SimCenter at Chattanooga.
- Faculty who teach courses or have significant interactions with students and other faculty will occupy space in the new Engineering, Mathematics and Computer Science building.
- The library requirements for this program are minimally different from that already existing for other programs in the College of Engineering and Science.

Research Funding History

Dr. D. L. Whitfield was one of three original co-founders of the National Science Foundation Engineering Research Center for Computational Field Simulation at

Mississippi State University. Later, Drs. T. W. Swafford and W. R. Briley became Co-Principal Investigators for this NSF Grant. There were three to five PIs for the NSF/ERC grant at different times, and this grant generated about $25,000,000 in funding during the complete eleven-year ERC cycle. The NSF/ERC at MSU was recognized by NSF as one of its most successful ERCs. Dr. Whitfield was also Director of the CFD Lab at the ERC, which became the Computational Simulation and Design Center (MSU SimCenter) in 2000. This organization included fifteen of the current full-time faculty and staff at the UT SimCenter at Chattanooga.

Drs. Whitfield, Briley, Taylor, Swafford, Arabshahi, and Sreenivas have been Principle Investigators (PI) and/or Co-PI on approximately 35 grants and contracts that either started or were completed during the past five years. These grants had various periods of performance ranging from 1-6 years and total funding of approximately $22,000,000 (not including the $25,000,000 NSF/ERC funding).

Sponsors of research:

Office of Naval Research 8 grants - $12,500,000
NASA Glenn Research Center 8 grants - $2,900,000
NASA Ames Research Center 1 grants - $970,000
NASA Langley Research Centers 3 grants - $245,000
National Science Foundation 1 grant - $500,000
Anny Research Laboratory 1 grant - $870,000
Naval Surface Warfare Center 3 grants - $ 85,000
Naval Sea Systems Command 1 grant – $100,000
Lockheed Martin 3 grants - $1,270,000
Northrup Grumman Ingalls 3 grants - $350,000
University of Michigan 1 grant - $850,000
Veridian ERIM 1 grant - $850,000
DEPSCoR 1 grant - $285,000

Dr. Henry McDonald, while serving as the center director of NASA Ames Research Center at Moffett Field, California from 1996-2002, successfully advocated for and then instituted four major new initiatives within NASA Ames. In addition to formulating and advocating the new initiatives, Dr McDonald was responsible for staffing the programs, preparing the program plans, and establishing goals and defending the programs. Dr. McDonald has also served as Principal Investigator for a very large number of research contracts sponsored by government and industry during his career.

The first of these was in the new field of astrobiology and this resulted in the establishment of an Astrobiology Institute at Ames that supported more than a dozen groups of researchers across the nation at an annual funding level in excess of $10,000,000 per year. The second initiative resulted in the establishment of a Nanotechnology Center at Ames with funding now in the range of $6,000,000 per year. The third initiative resulted in the creation of the Intelligent Systems Program led by Ames and this was funded at a level of $40,000,000 per year. The fourth initiative led to the creation of the Complex Systems Initiative which initially was funded at a level of $20,000,000 per year.

ESTIMATE OF NEW COSTS

	Year 1	Year 2	Year 3	Year 4	Year 5
Administrative	$20,000	$26,400	$30,600	$33,000	$33,000
Faculty	68,000	84,500	104,300	112,500	112,500
Clerical/support	10,000	12,400	15,300	16,500	16,500
Library					
Equipment					
Travel					
Total	**$98,000**	**$123,300**	**$150,200**	**$162,000**	**$162,000**

1.1.30 POST APPROVAL MONITORING: An annual performance review of the proposed program will be conducted for the first five years following approval. The review will be based on goals established in the approved program proposal. At the end of this period, campus, governing board, and Commission staff will perform a summative evaluation. The goals will include, but not be limited to enrollment and graduation numbers, program cost, progress toward accreditation, library acquisitions, student performance, and other goals set by the institution and agreed to by governing board and Commission staff. As a result of this evaluation, if the program is found to be deficient, the Commission may recommend that the governing board terminate the program. Copies of such recommendation will be forwarded to the Education Committees of the General Assembly. The Commission may also choose to extend this period if additional time is needed and requested by the governing board.